NAST-I Observations

Bill Smith, Dan Zhou, and Allen Larar
NASA Langley Research Center

CLAMS DATA WORKSHOP
Science Systems & Application
Lanham, MD 20706
February 26 – 27, 2002

Proteus Participation in CLAMS

Aircraft Performance

Ceiling 56-62 kft
Airspeed 100-350 ktas
Endurance 12-22 hrs
Minimum Operating Altitude:
100 ft (Can Profile)

Instruments

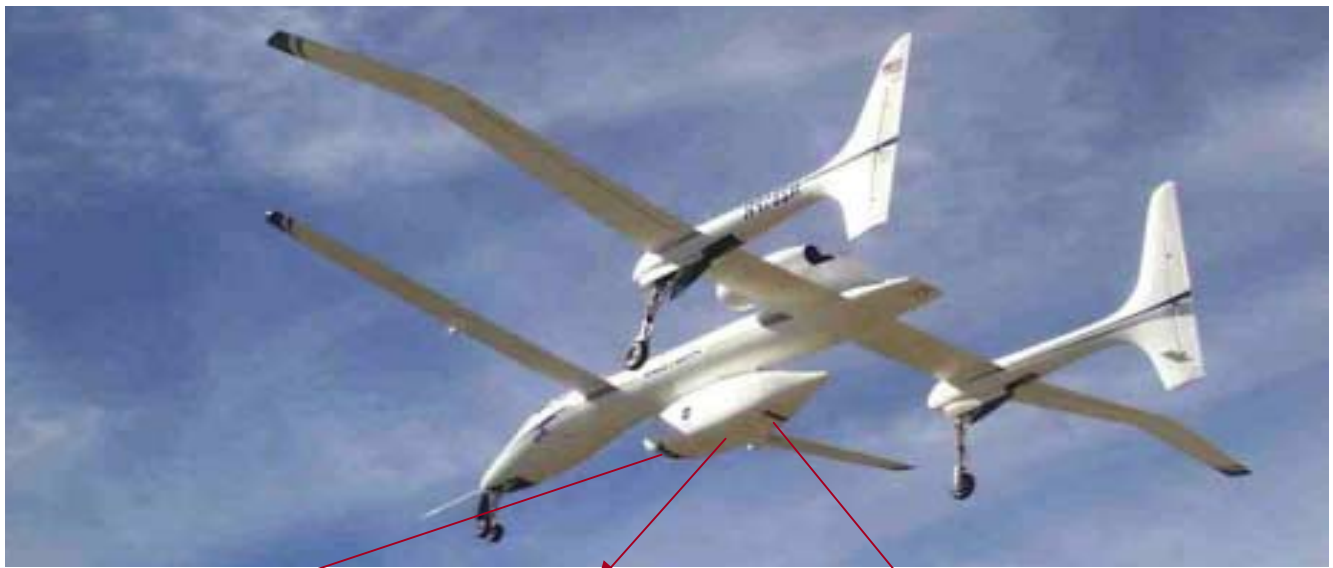
IR Interferometer (NAST-I)
Spectral Range: 3.5 - 16 Microns
Spectral Resolution: >2000 (0.25 cm^{-1})

Microwave Radiometers (NAST-M)
Spectral Regions: 50 - 60 GHz
113 - 119 GHz

Far-Infrared Interferometer (FIRSC)
Spectral Range: 75 – 1000 microns
Spectral Resolution: >100 (0.1 cm^{-1})

NAST / FIRSC Payload on Proteus

- NAST Interferometer (NAST-I) Microwave (NAST-M)
  - Far-Infrared Sensor for Cirrus (FIRSC)



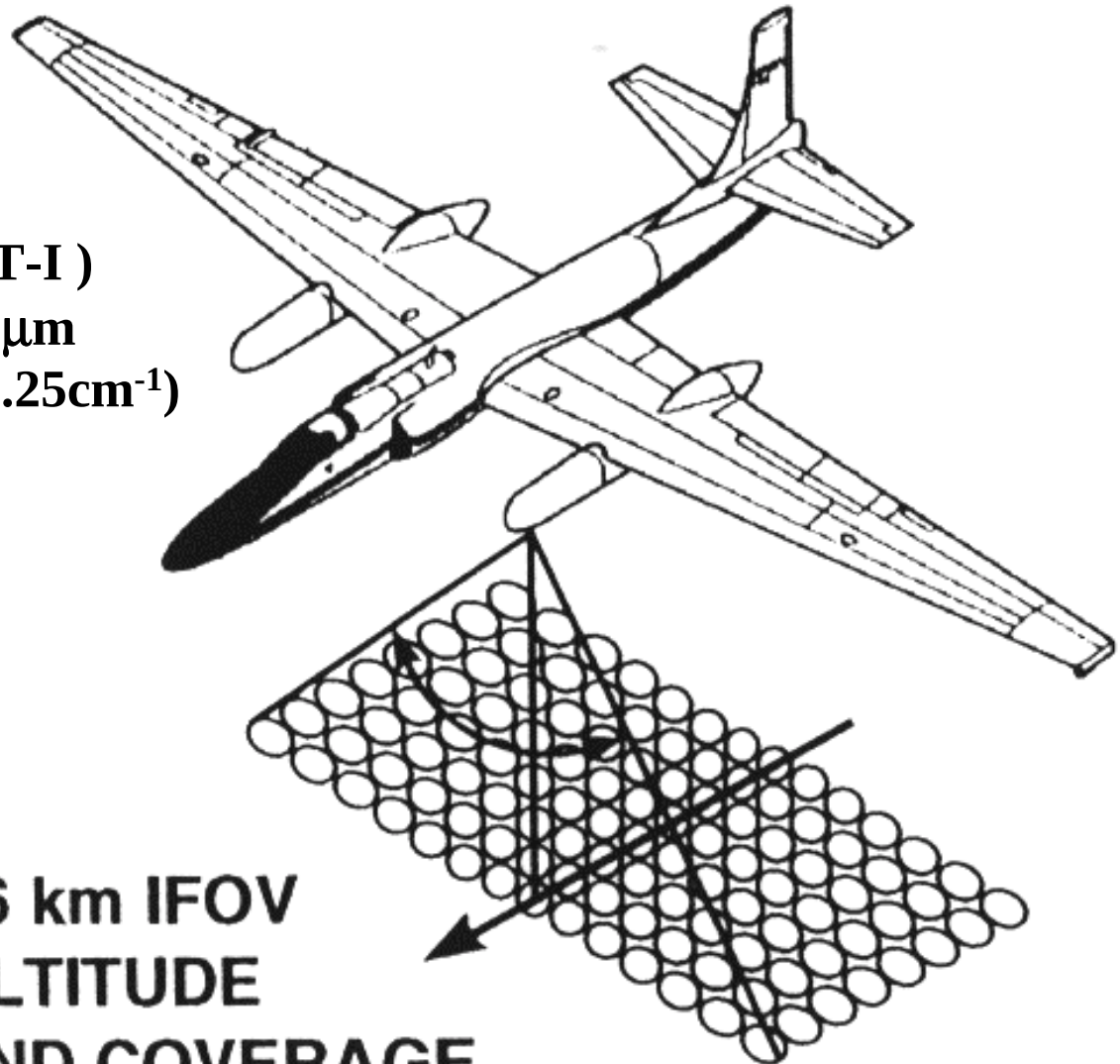
NAST-M

FIRSC

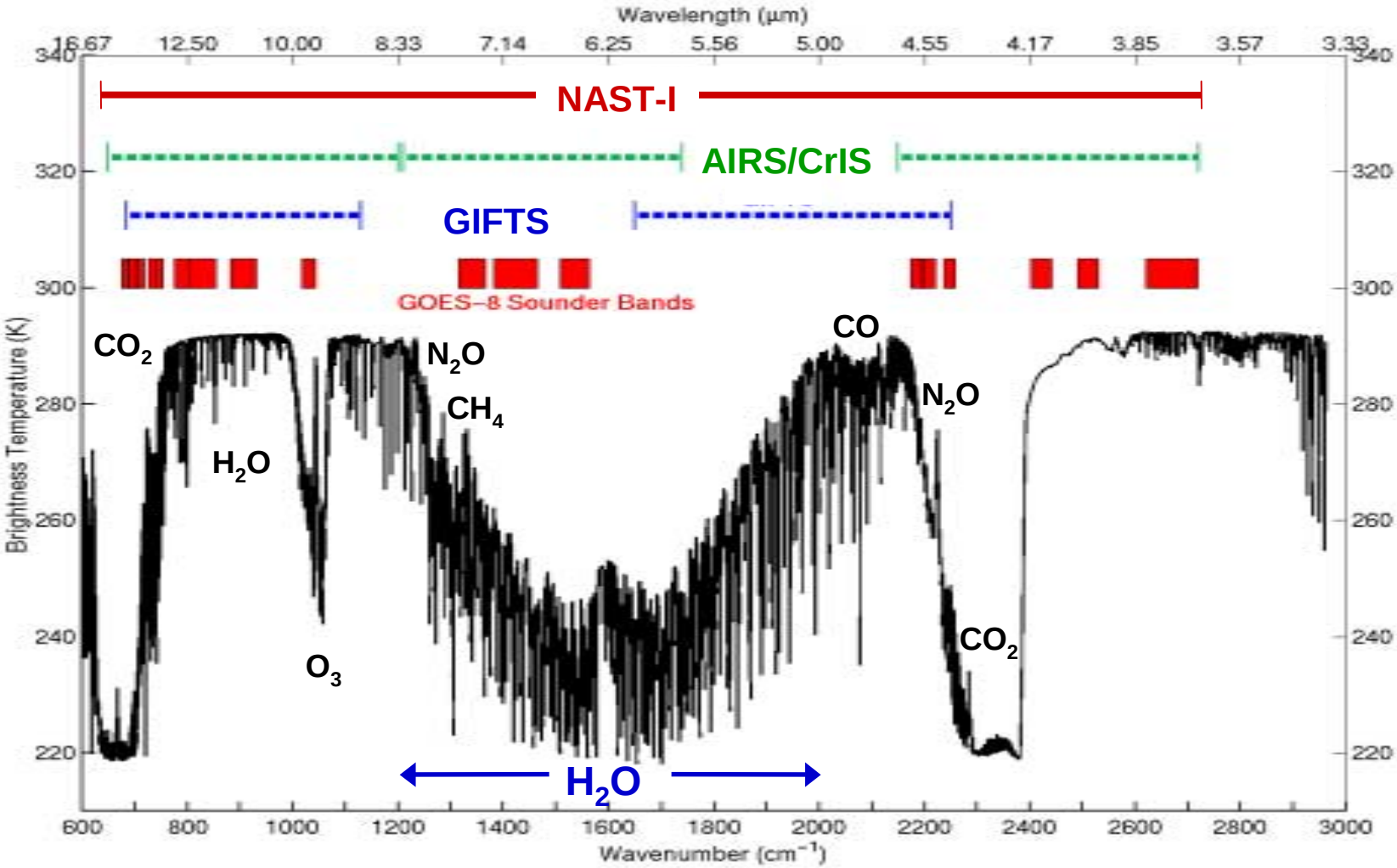
NAST-I

NPOESS Airborne Sounder Testbed (NAST)

IR interferometer (NAST-I)
Spectral Range: 3.5 – 16 μm
Spectral Resolution:>2000 (0.25cm^{-1})

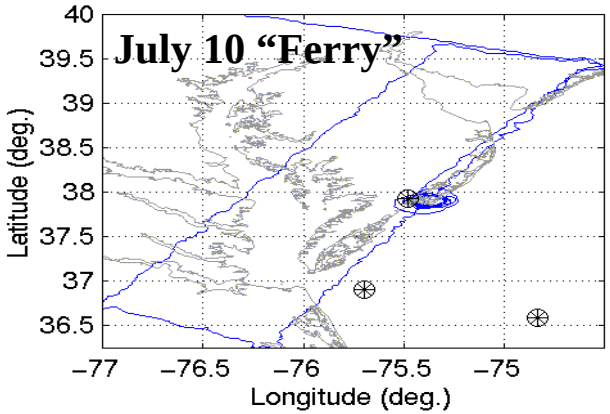


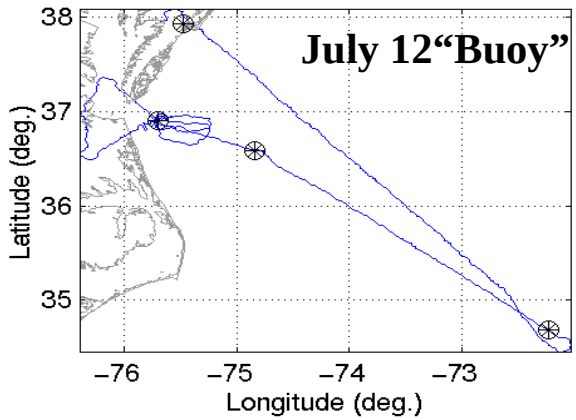
Spectral Coverage Comparison

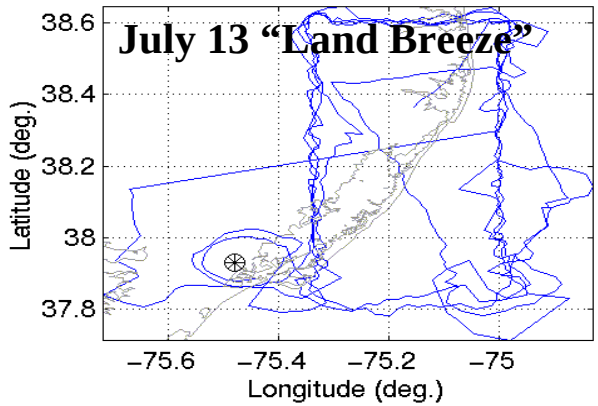


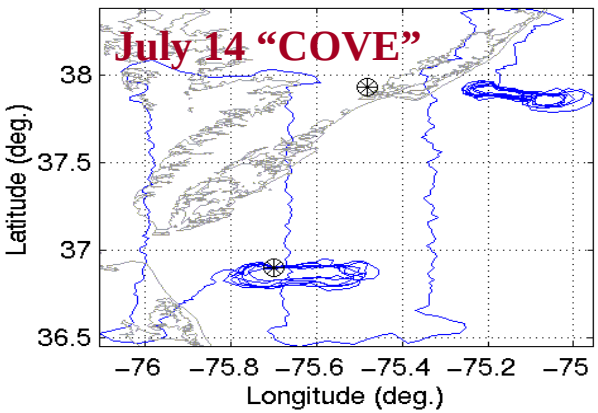
Spectral Coverage Encompasses all future satellite sounders

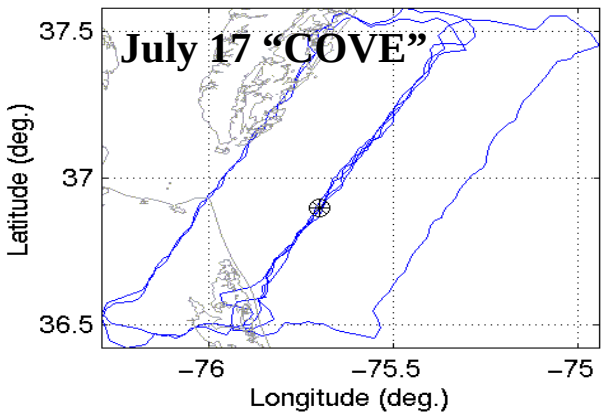
CLAMS Flight Tracks

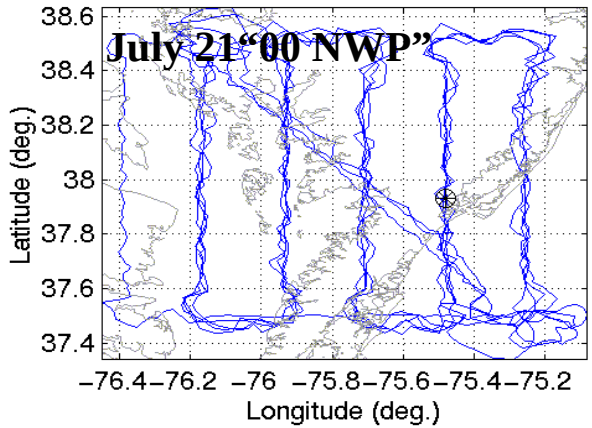


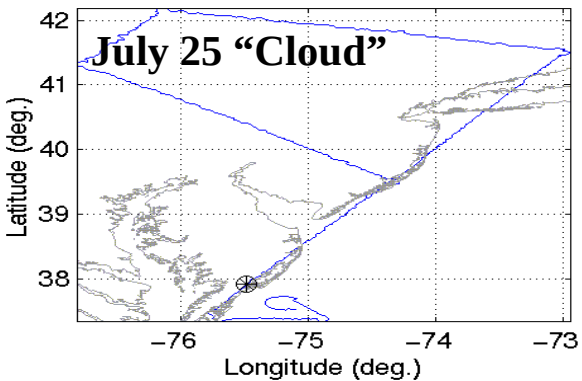


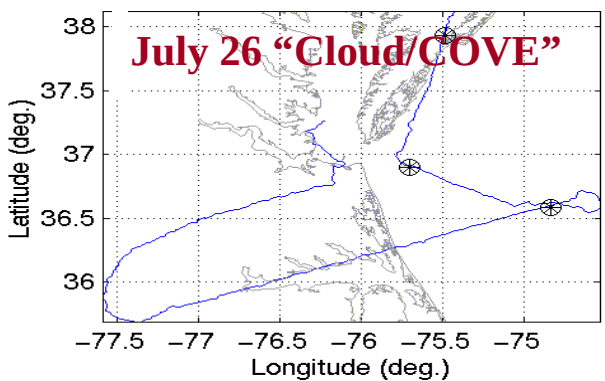


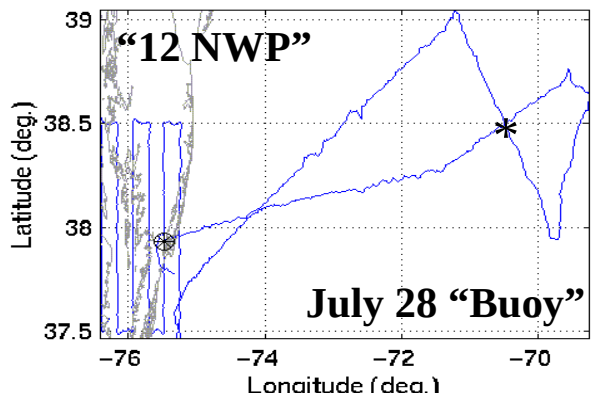






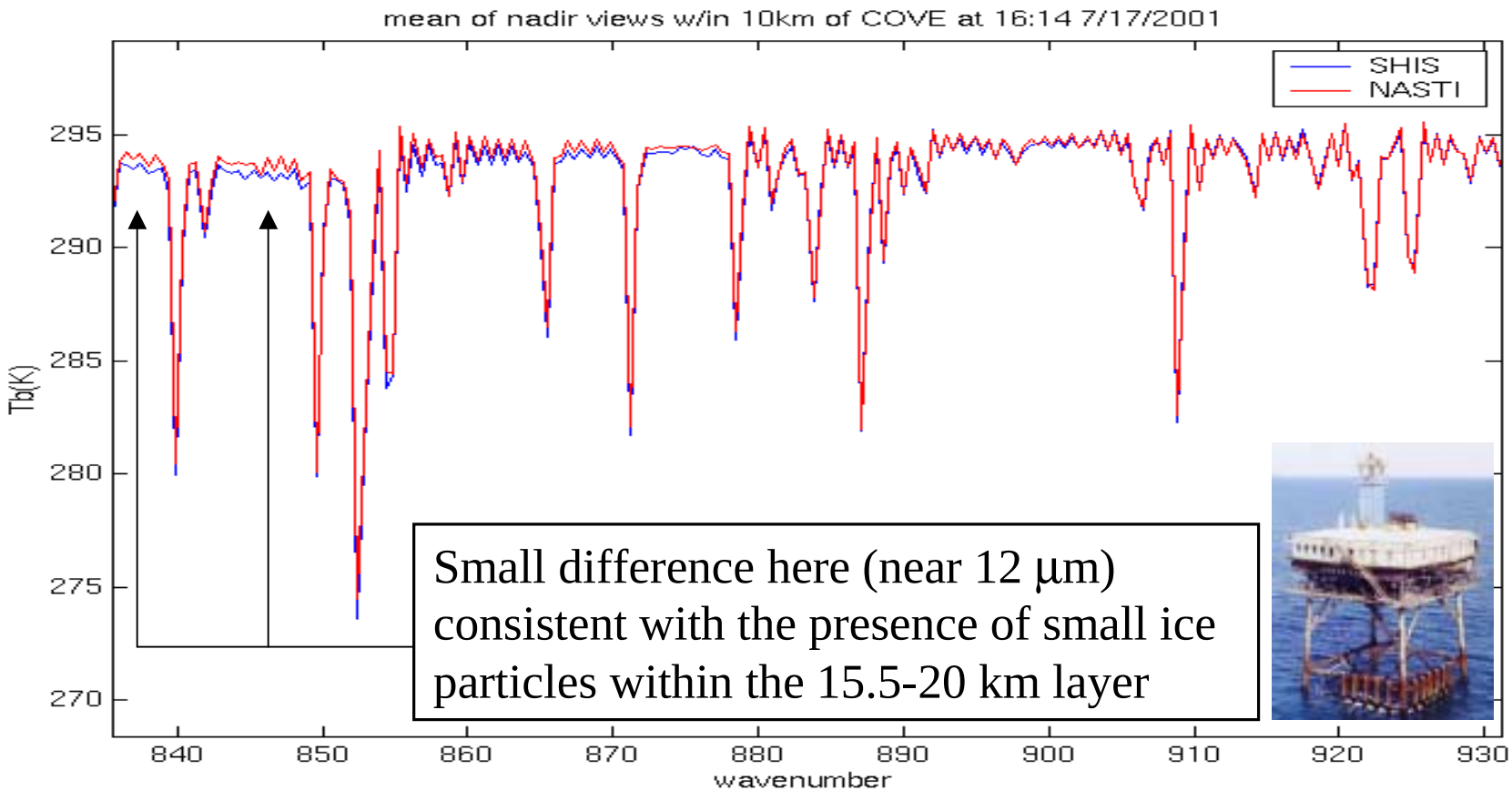




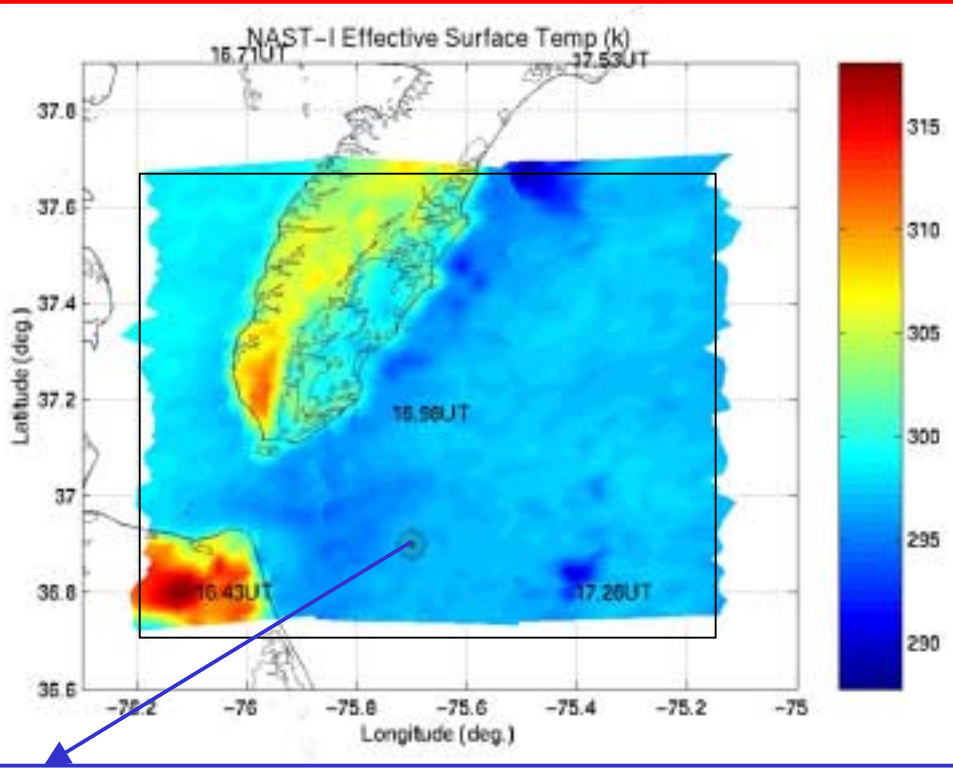


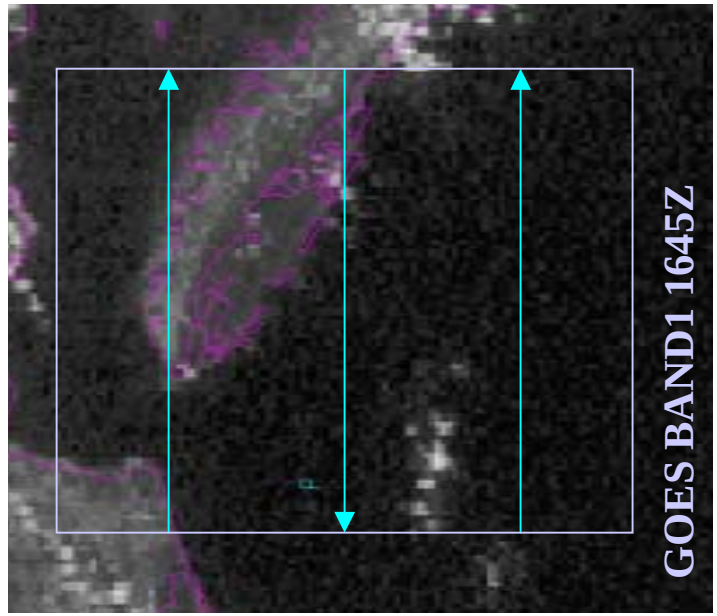
NASTI & SHIS Comparisons (July 17, 2001)

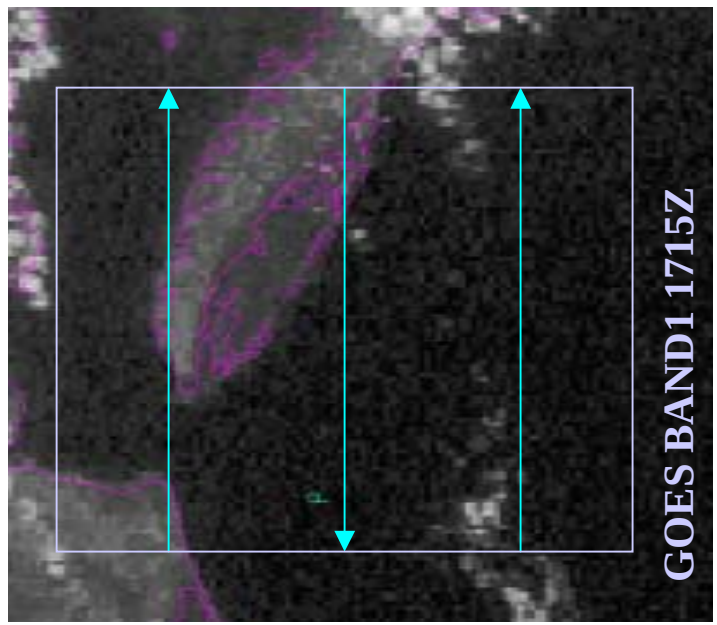
"Window" region spectral radiance comparison between NAST-I on Proteus (~15.5 km) and SHIS on the ER-2 (~20 km) near the Chesapeake Lighthouse



Surface Skin Temperature (July 14, 2001)



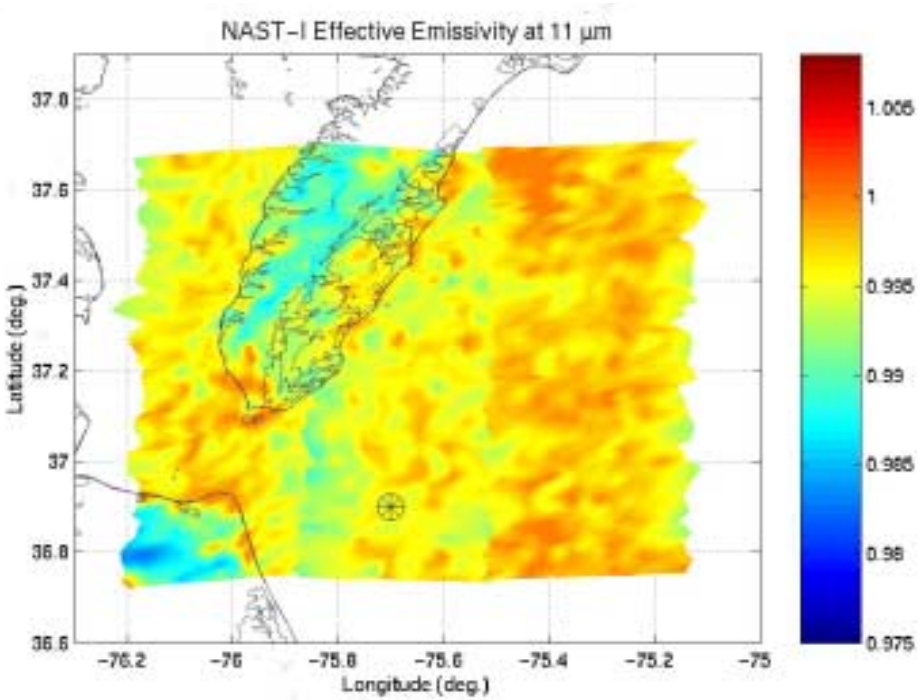


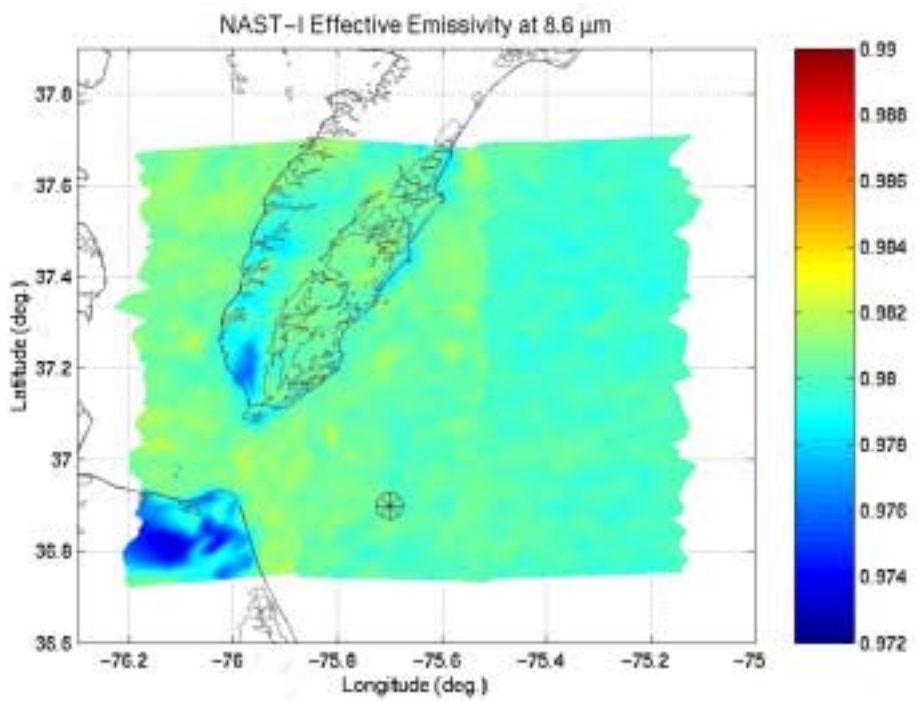


296.89° K (σ = 0.21° K) ← NAST-I retrieved (within ±0.02° Lat. and Lon.)
297.45° K ← NOAA buoy site CHLV2 measured (i.e., the bulk SST).

The cold "skin", observed by NAST-I, relative to the sub-surface water, observed by the buoy, is expected as a result of evaporative cooling.

Surface Emissivity (July 14, 2001)

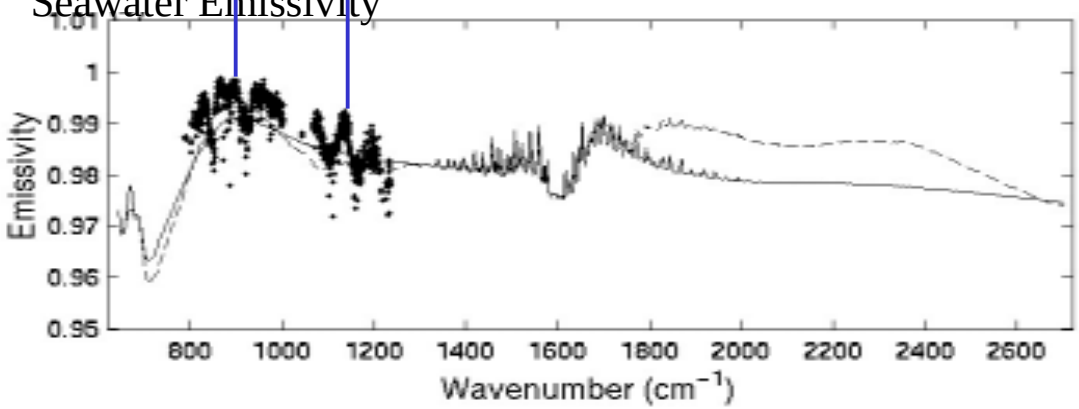




11 μm

8.6 μm

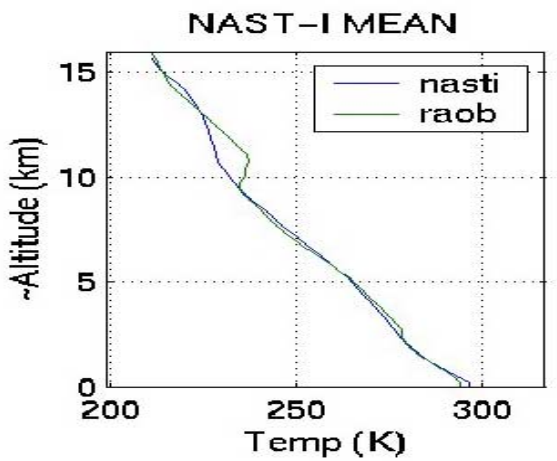
Seawater Emissivity

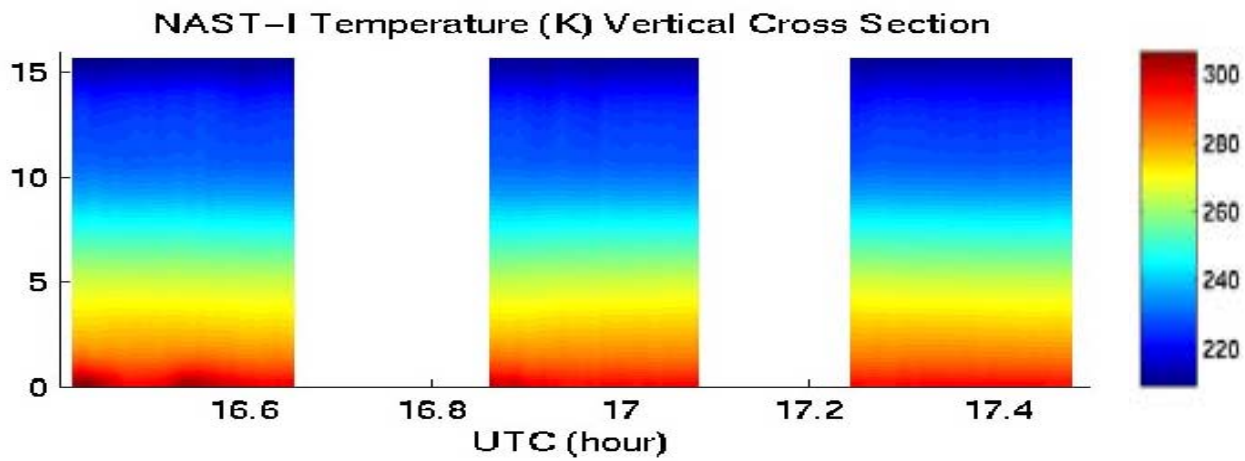


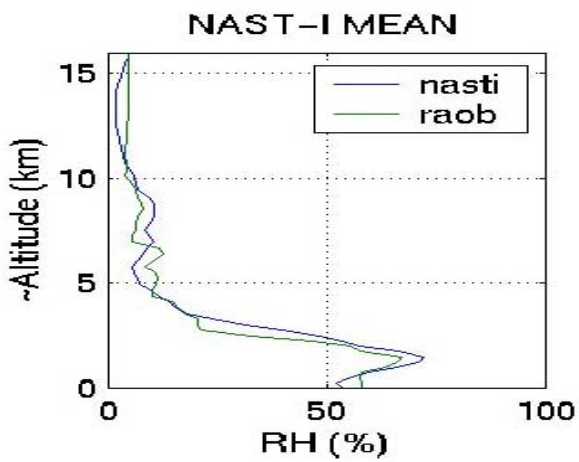
- Laboratory measured ← solid
- NAST-I retrieved at the LH ← dashed
- NAST-I validated ← dots

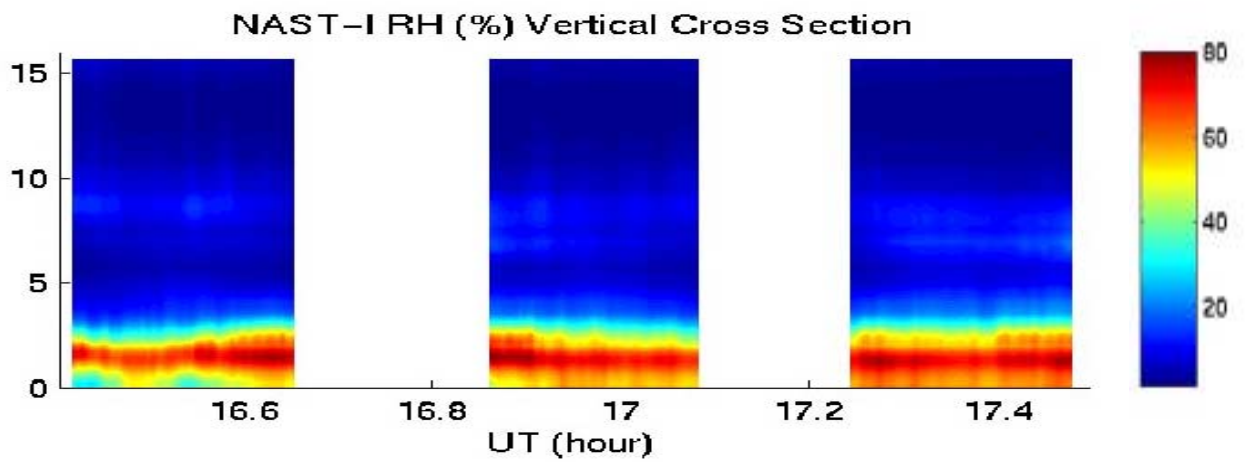
$$\varepsilon = (R_{obs} - A^{\uparrow} - A^{\downarrow}) / (B_S \tau_S - A^{\downarrow})$$

Vertical Cross-section (July 14, 2001)





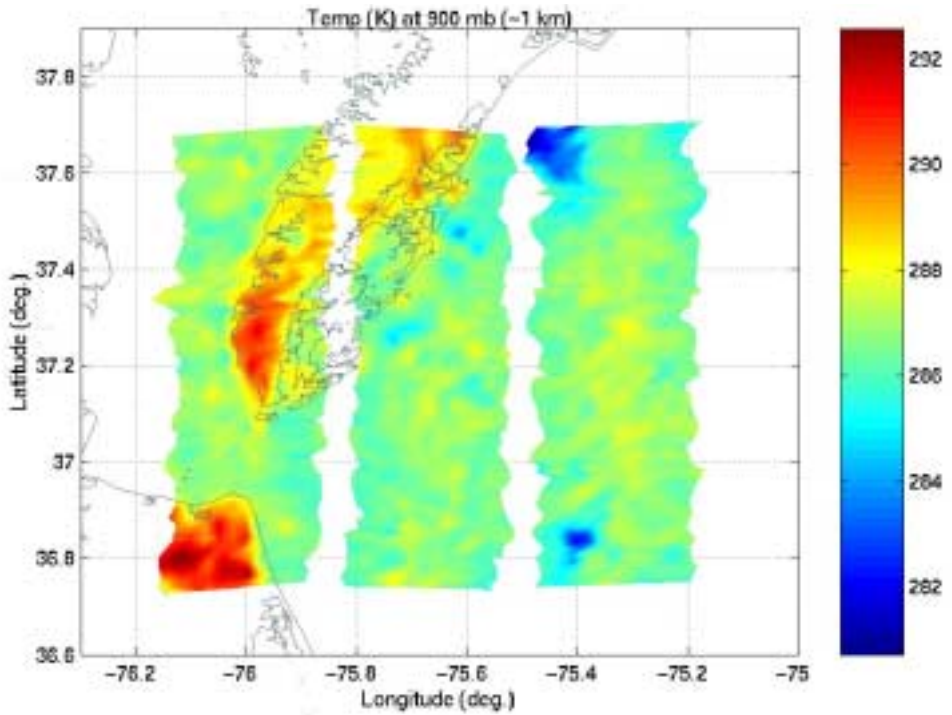


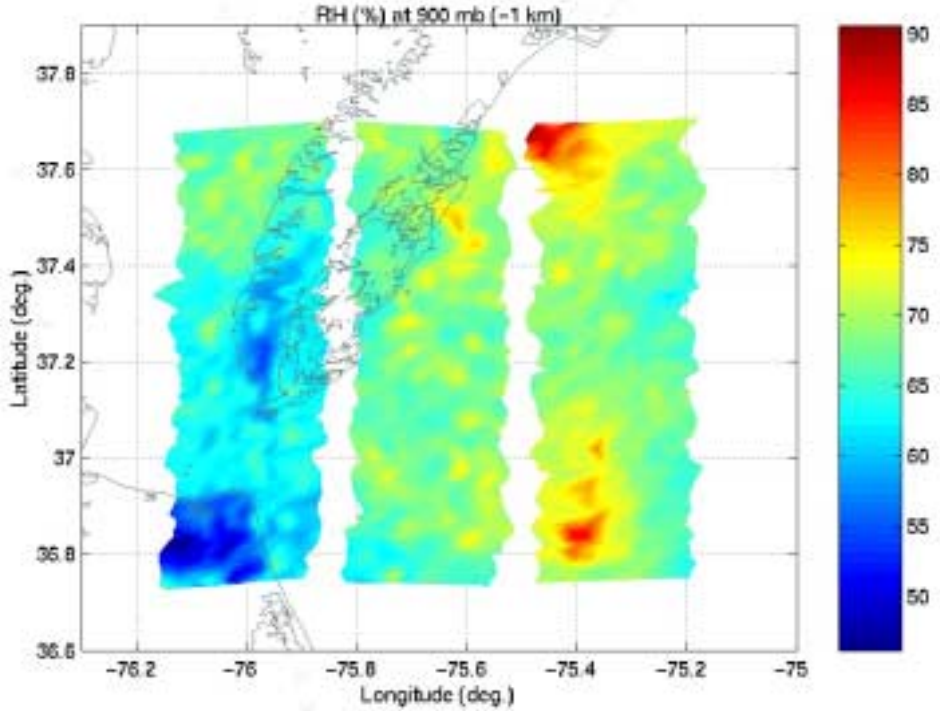


IR Window Image Along Track

Horizontal Cross-section @ 900 mb (July 14, 2001)

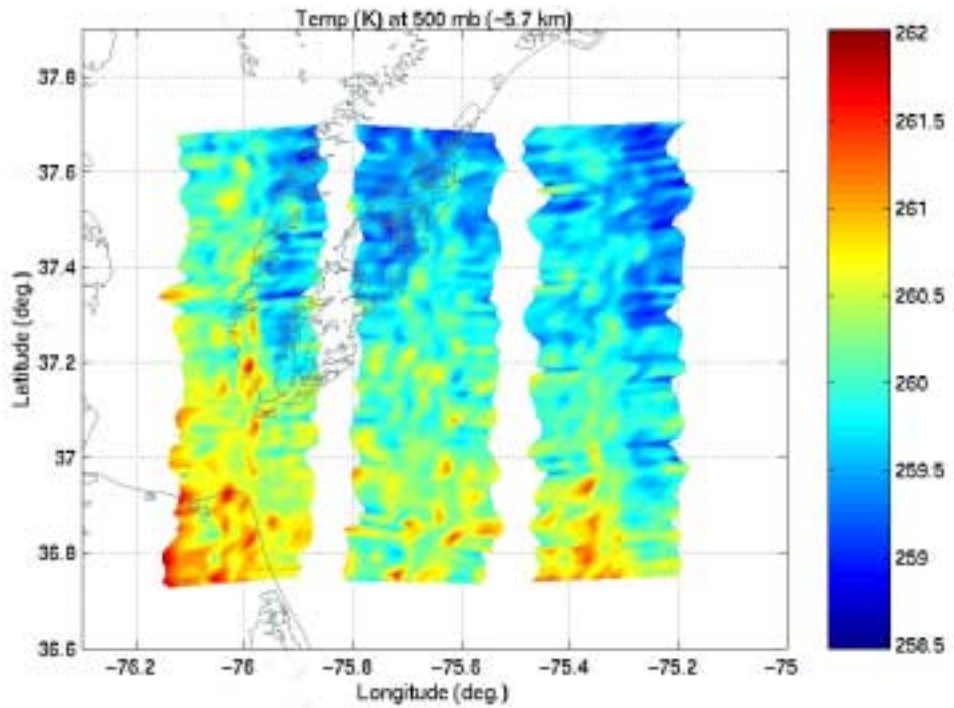
Temperature and moisture horizontal distributions at 900 mb (~1 km above sea level)

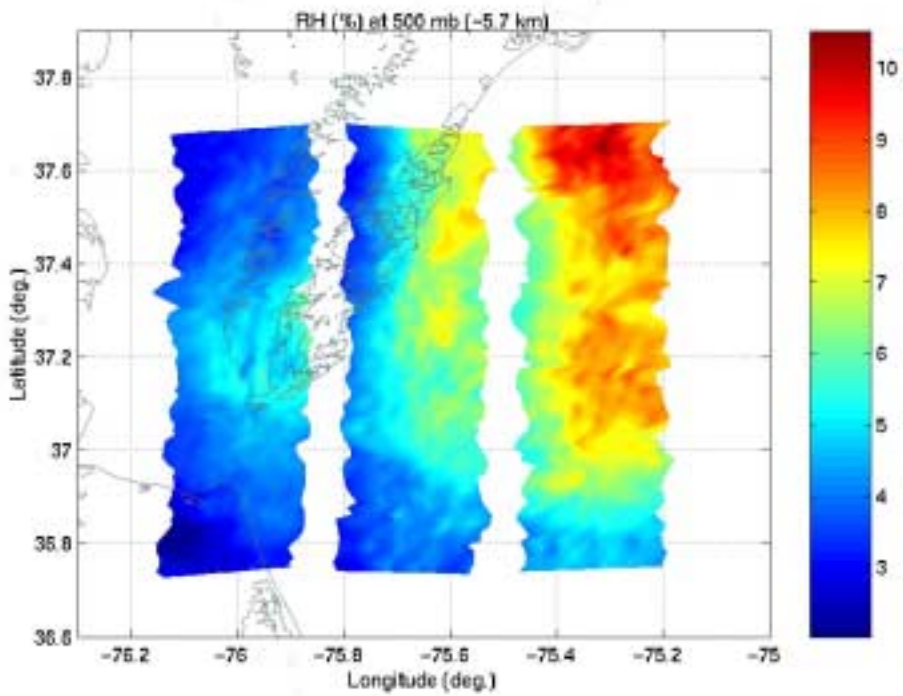




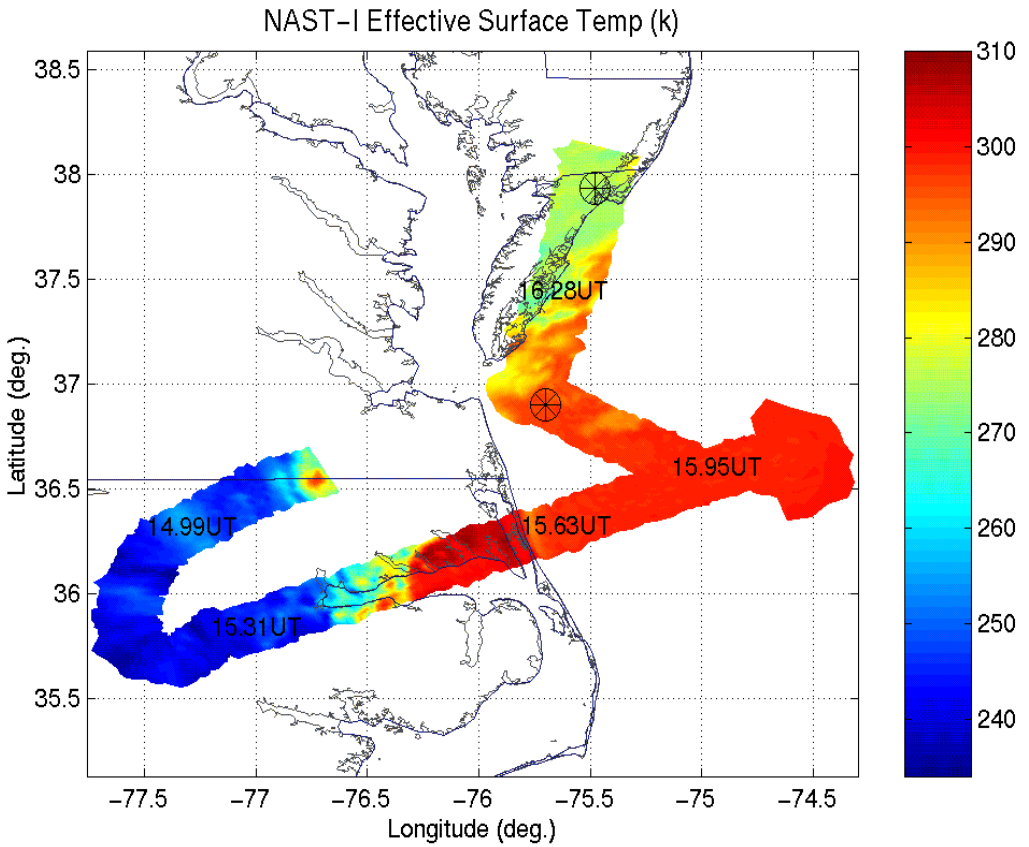
Horizontal Cross-section @ 500 mb (July 14, 2001)

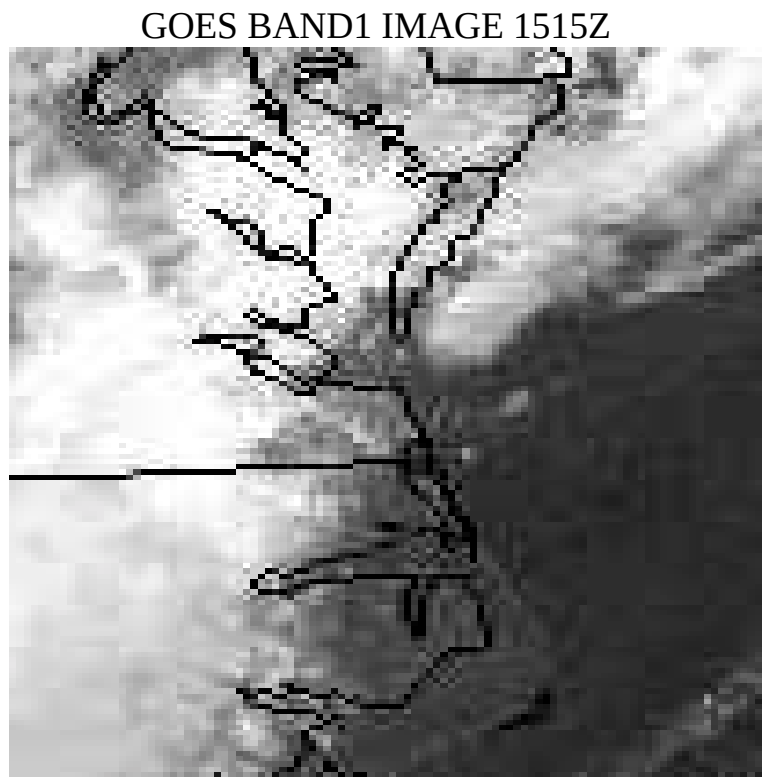
Temperature and moisture horizontal distributions at 500 mb (~5.7 km above sea level)





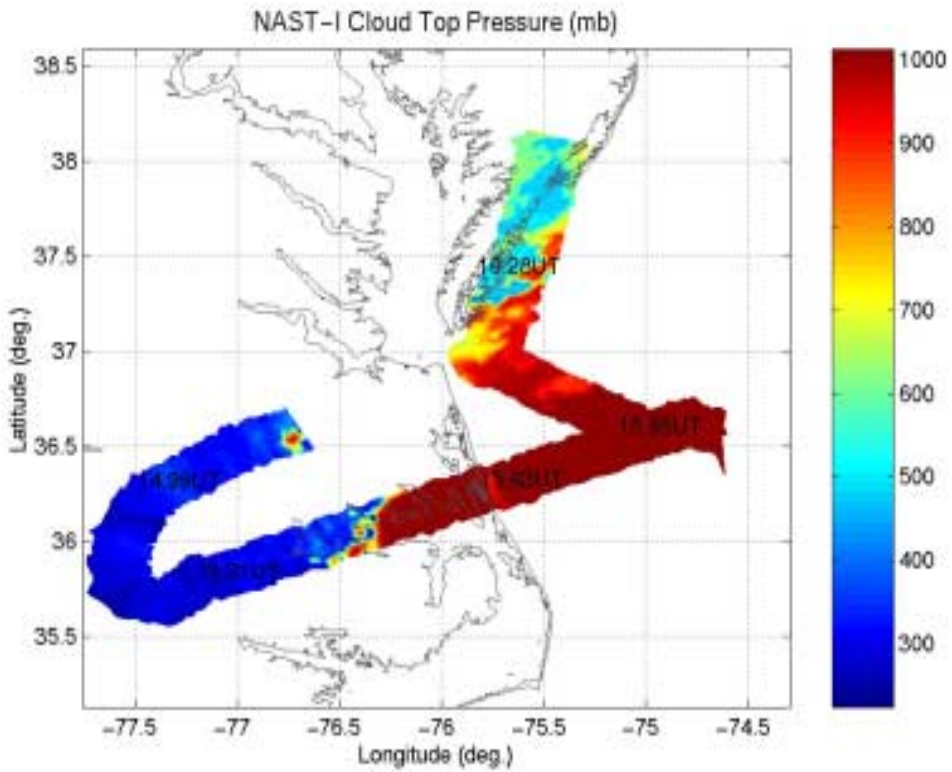
Effective Surface Temperature (July 26, 2001)

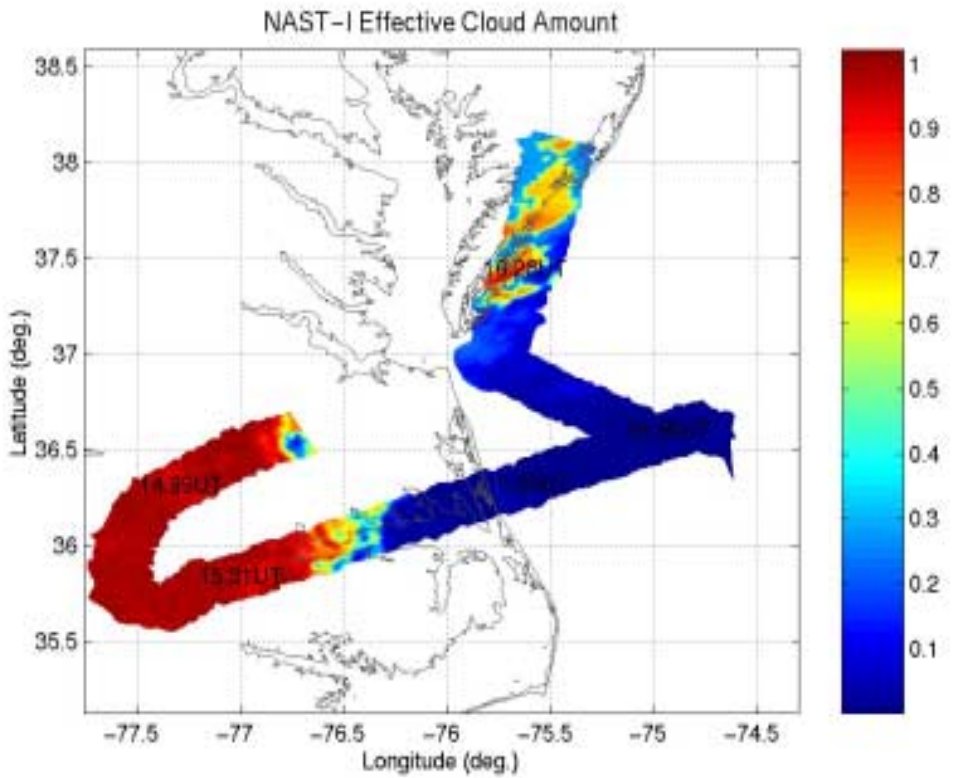


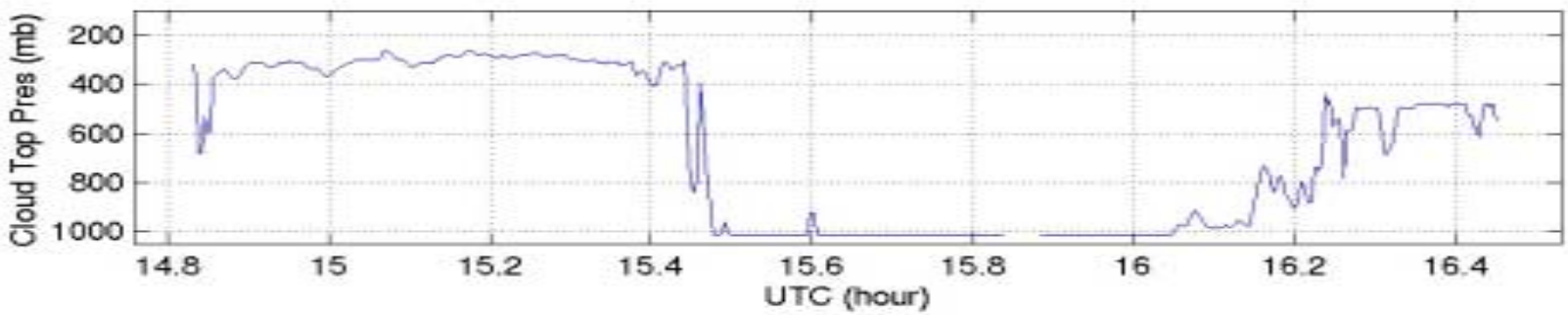


High dense convective clouds over North Carolina and low cumulus clouds over the Delmarva peninsula

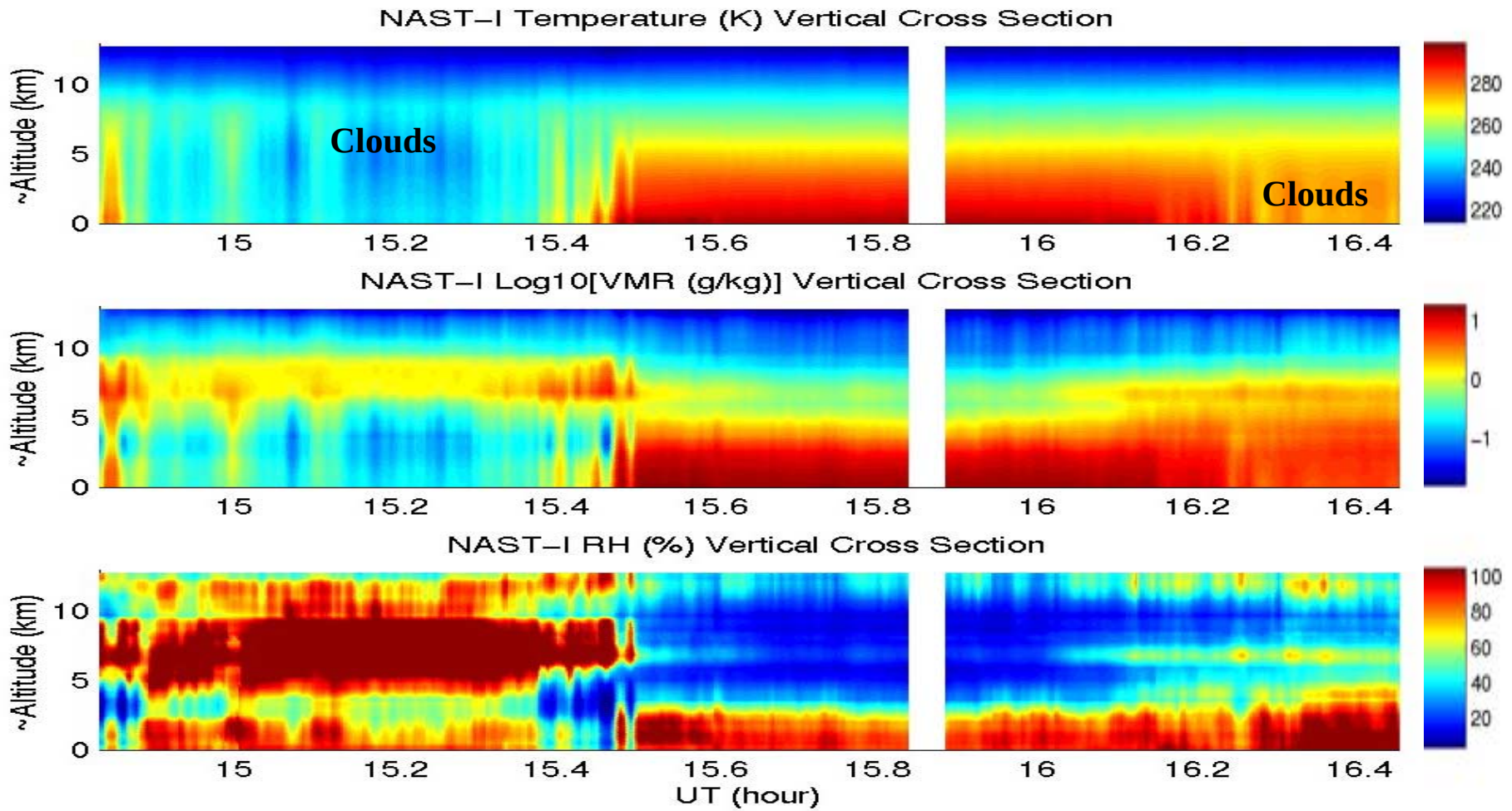
Effective Cloud Properties (July 26, 2001)





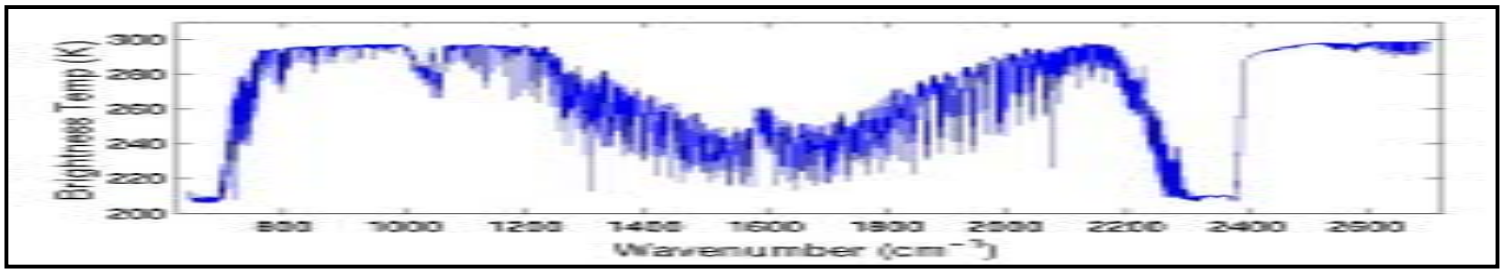


Vertical Cross-section (July 26, 2001)



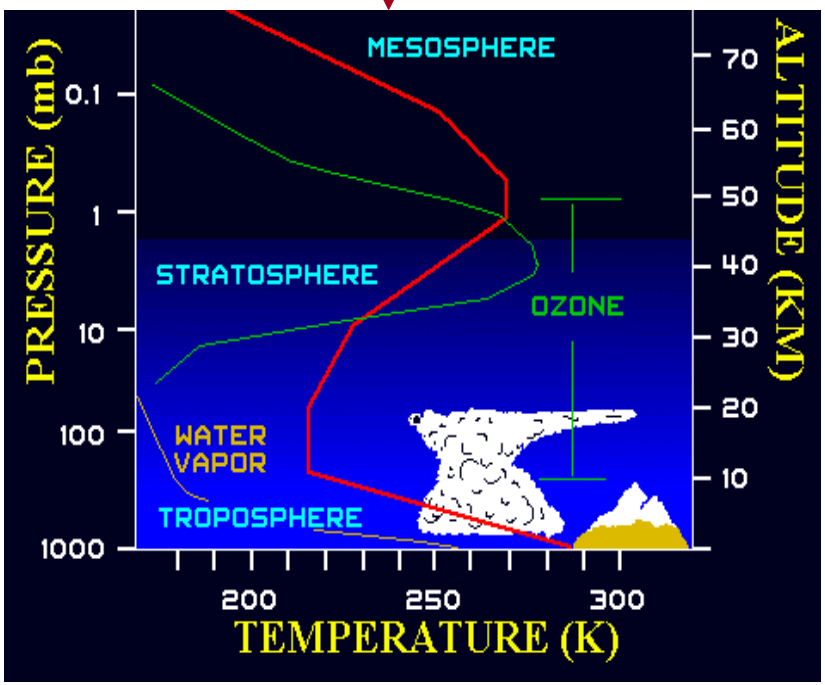
IR Window Image Along Track

CLAMS NAST-I Data Products



Calibrated Brightness Temperature or Radiance Spectrum

NUMERICAL INVERSION



Vertical Sounding and Surface properties

Retrievals (clear sky conditions)

- Surface skin temperature and emissivity
- Atmospheric temperature and moisture profiles

Retrievals (cloudy sky conditions)

- Cloud top pressure and temperature
- Effective cloud amount (i.e., emissivity/cloud fraction product)
- Atmospheric profiles about clouds